VERIFICATION OF TRANSLATION

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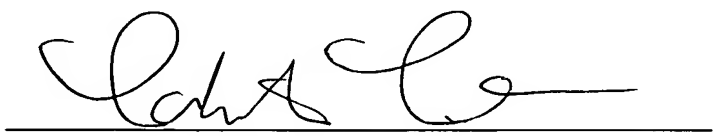
do hereby declare that I have a thorough knowledge of the Japanese and English languages and that the writing contained in the following pages is a correct translation of the attached Japanese Patent Office Certificate bearing the file reference

Japanese Patent Application No. 2002-274128

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the above-captioned application or any patent issuing therefrom.

Declared at Tokyo, Japan
This 5th day of October, 2006



Ichitaro Ito

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[Title of the Invention]	**MOBILE COMMUNICATION SYSTEM, MOBILE STATION AND RADIO NETWORK CONTROLLER**
[The Number of Claims]	4
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[List of Filed Documents]

[Document]	Specification	1
[Document]	Claims	1
[Document]	Drawing	1
[Document]	Abstract	1
[Number of General Power of Attorney]		9702416
[Necessity of Proof]		Yes

[Name of Document] SPECIFICATION

[Title of the Invention]

MOBILE COMMUNICATION SYSTEM, MOBILE STATION AND RADIO NETWORK CONTROLLER

[Claim for a Patent]

[Claim 1]

A mobile Communication system configuring a radio network controller, base stations and mobile stations, to perform multicast communication, wherein

the radio network controller comprises a control signal transmitter configured to divide a multicast group into subgroups, to divide a control signal for the multicast group into control signals for the subgroups, and to transmit the control signals for the subgroups to the base station; and

the mobile station comprises:

a response signal creator configured to create a response signal to the control signal for at least one subgroup;

a transmission timing detector configured to detect a transmission timing of the response signal from the control signal for at least one subgroup; and

a response signal transmitter configured to transmit the response signal to the base station with the transmission timing.

[Claim 2]

A mobile station supporting multicast communication, the mobile station comprising:

a response signal creator configured to create a response signal to a control signal for at least one subgroup into which a control signal for multicast group is divided;

a transmission timing detector configured to detect a transmission timing of the response signal from the control signal for at least one subgroup; and

a response signal transmitter configured to transmit the response signal to a base station with the transmission timing.

[Claim 3]

A radio network controller supporting multicast communication, the radio network controller comprising:

a control signal transmitter configured to divide a multicast group into subgroups, to divide a control signal for the multicast group into control signals for the subgroups, and to transmit the control signals for the subgroups to a base station.

[Claim 4]

The radio network controller according to claim 3, wherein

the radio network controller performs a predetermined processing on a predetermined number of response signals, the predetermined number of response signals responding to the control signal for the multicast group and being transmitted from mobile stations joining in the multicast group; and

the radio network controller performs processing on only the predetermined number

of response signals, and any following response signal is unprocessed by the radio network controller, the following response signals being transmitted from the mobile stations joining in the multicast group.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a mobile communication system, a mobile station and a radio network controller which support multicast communication.

[0002]

[Prior Art]

As shown in FIG. 5, a broadcast communication whereby a plurality of base stations 11 to 17 transmit common information to unspecified mobile stations 101 to 112 in predetermined areas is known in a conventional mobile communication system. (For example; non-patent literature 1)

[0003]

In addition, as shown in FIG. 6, multicast communication whereby a plurality of base stations 11 to 17 transmit common information to specific mobile stations belonging to a specific group is known in a conventional mobile communication system. (For example; non-patent literature 2)

[0004]

In the multicast communication, a plurality of mobile stations forms one multicast group. In order to start the multicast communication, one PICH (Paging indicator channel) is transmitted to each multicast group, and each mobile station returns a response signal to the received PICH.

[0005]

[Non-Patent Literature 1]

3rd Generation Partnership Project Technical Specification Gro up Terminals, 23.041 Technical realization of Cell Broadcast Service(CBS), October, 2000

[Non-Patent Literature 2]

3rd Generation Partnership Project Technical Specification Gro up Radio Access Network, 25.324 Broadcast/Multicast Control BNC, December, 2000

[0006]

[Problems to be Solved by the Invention]

However, there is a problem in that a plurality of response signals are transmitted to the radio network controller RNC at approximately the same time even though the multicast communication can be started with one response signal, so that the load on receiving control of the radio network controller RNC is increased in the conventional multicast communication.

[0007]
In viewing of the foregoing, it is an object of the present invention to provide a mobile communication system which can reduce the load on the radio network controller during multicast communication, a mobile station and a radio network controller which can be used in the above mobile communication system.

[0008]
A first aspect of the present invention is summarized as a mobile communication system having a radio network controller, base stations and mobile stations, to perform multicast communication. The radio network controller comprises a control signal transmitter configured to divide a multicast group into subgroups, to divide a control signal for the multicast group into control signals for the subgroups and to transmit the control signals for the subgroups to the base station. The mobile station comprises a response signal creator configured to create a response signal to the control signal for at least one subgroup, a transmission timing detector configured to detect a transmission timing of the response signal from the control signal for at least one subgroup, and a response signal transmitter configured to transmit the response signal to the base station with the transmission timing.
[0009]
A second aspect of the present invention is summarized as a mobile station supporting multicast communication. The mobile station comprises a response signal creator configured to create a response signal to a control signal for at least one subgroup into which a control signal for multicast group is divided, a transmission timing detector configured to detect a transmission timing of the response signal from the control signal for at least one subgroup, and a response signal transmitter configured to transmit the response signal to a base station with the transmission timing.
[0010]
A third aspect of the present invention is summarized as a radio network controller supporting multicast communication. The radio network controller comprises a control signal transmitter configured to divide a multicast group into subgroups, to divide a control signal for the multicast group into control signals for the subgroups, and to transmit the control signals for the subgroups to a base station.
[0011]
In the third aspect, it is desirable that the radio network controller perform a predetermined processing on a predetermined number of response signals and any following response signals are unprocessed, after receiving either the first response signal or a predetermined number of response signals respond to the control signal and are transmitted from mobile stations joining in the multicast group.
[0012]
[Embodiment of the Invention]
<A configuration of a mobile communication system according to an embodiment of the

present invention>

FIG. 1 shows the entire configuration of a mobile communication system according to an embodiment of the present invention.

[0013]

As shown in FIG. 1, the mobile communication system according to the embodiment comprises four base stations 10, 20, 30 and 40 under a radio network controller 50. In the mobile communication system according to the embodiment, the base station 10 manages mobile stations 11 to 13, the base station 20 manages mobile stations 21 and 22, the base station 30 manages mobile stations 31 and 32, and the base station 40 manages mobile stations 41 to 43.

[0014]

Herein, the mobile stations 11, 12, 21, 41, 42 and 43 are assumed to join in the same multicast group A in the embodiment.

[0015]

The radio network controller 50 divides the multicast group A into three subgroups A1 to A3 in the embodiment. The radio network controller 50 allocates each of six mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A to one of the subgroups A1 to A3. For example, the radio network controller 50 allocates the mobile station 11 and 12 to the subgroup A1, allocates the mobile station 21 and 41 to the subgroup A2, and allocates the mobile station 42 and 43 to the subgroup A3.

[0016]

FIG. 2 shows a functional block diagram of the mobile station used in the Mobile Communication system according to the embodiment. Functions of a plurality of mobile stations 11 to 43 are basically the same, so that the function of the mobile station 11 will be explained as follows.

[0017]

As shown in FIG. 2, the mobile station 11 is configured with a control signal receiver 11a, a response signal transmitter 11b, a response signal creator 11c and transmission timing detector 11d.

[0018]

The control signal receiver 11a is configured to receive a control signal for the multicast group A and a control signal for the subgroup A1 which are transmitted from the base station 10.

[0019]

The response signal creator 11c is configured to create a response signal to the control signal for the multicast group A or the control signal for the subgroup A1. In this embodiment, the response signal creator 11c comprises the response signal creator configured to create a response signal for control signal in the subgroup A.

[0020]

The transmission timing detector 11d is configured to detect a transmission timing of the response signal in the subgroup A1 from the received control signal for the subgroup A1. In

this embodiment, the transmission timing detector 11d comprises the transmission timing detector configured to detect the transmission timing of the response signal from the control signal transmitted to subgroup A1.

[0021]

For example, the transmission timing detector 11d can detect 100ms as the transmission timing of the response signal in the subgroup A1, detect 200ms as the transmission timing of the response signal in the subgroup A2, detect 300ms as the transmission timing of the response signal in the subgroup A3.

[0022]

The transmission timing detector 11d is configured to detect a time X (e.g. 19:00) as the transmission timing of subgroup A1, detect a time Y (e.g.19:01) as the transmission timing of the subgroup A2, and detect a time Z (e.g. 19:02) as the transmission timing of the subgroup A3.

[0023]

The response signal transmitter 11b is configured to transmit the created response signal to the base station 10 with the detected transmission timing. In this embodiment, the response signal transmitter 11b comprises the response signal transmitter configured to transmit the response signal to the base station with the detected transmission timing.

[0024]

For example, the response signal transmitter 11b transmits the response signal to the base station 10 100ms after receiving the control signal for the subgroup A1 (or at the time X), transmits the response signal to the base station 10 200ms after receiving the control signal for the subgroup A3 (or at the time Y), and transmits the response signal to the base station 10 300ms after receiving the control signal for the subgroup A3 (or at the time Z).

[0025]

FIG. 3 shows a functional block diagram of the radio network controller 50 used in the mobile communication system according to the embodiment.

[0026]

As shown in FIG. 3, the radio network controller 50 is configured with a response signal receiver 50a, a control signal transmitter 50b and a subgroup divider 50c.

[0027]

The subgroup divider 50c is configured to divide the multicast group A into the subgroups A1 to A3, and to divide a control signal for the multicast group A into control signals for the subgroups A1 to A3.

[0028]

The control signal transmitter 50b is configured to transmit the control signals for the subgroups A1 to A3 to the base station 10.

[0029]

This embodiment comprising the control signal transmitter wherein the control signal transmitter 50b and the subgroup divider 50c divides the multicast group into subgroups,

further transmits the control signal for multicast group divided into the control signal for the subgroups.

[0030]

The response signal receiver 50a is configured to receive the response signal to the control signal for the multicast group A from the mobile stations 11 and 12 at a different time.

[0031]

Referring to FIG. 4, the operation where the radio network controller 50 performs predetermined processing (for example, a service notice processing, or an authentication processing) on the mobile stations 11, 12, 21, 41, 42, 43 joining in the multicast group A in the mobile communication system according to the embodiment will be described.

[0032]

In step 1001, the radio network controller 50 allocates each of six mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A to one of the subgroups A1 to A3.

[0033]

In step 1002, the radio network controller 50 transmits a control signal such as a service notice signal and an authentication signal (a control signal for each of the subgroups A1 to A3) to three base stations 10, 20 and 40.

[0034]

In step 1003, each of the base stations 10, 20 and 40 receives the control signal transmitted from the radio network controller 50. The control signals transmitted by each of the base stations 10, 20 and 40 reach the mobile stations 11, 12, 21, 41, 42 and 43 joining in the multicast group A under the base stations 10, 20 and 40.

[0035]

In step 1004, each of the mobile stations 11, 12, 21, 41, 42 and 43 receives the control signal from each of the base stations 10, 20 and 40, and detects transmission timing of a response signal in the subgroup A1, A2 or A3.

[0036]

In step 1005, each of the mobile stations 11, 12, 21, 41, 42 and 43 creates the response signal to the control signal for the each of the subgroups A1 to A3, and transmits the response signal to the base stations 10, 20 and 40 with the detected transmission timing.

[0037]

In step 1006, each of the base stations 10, 20 and 40 receives the response signal from each of the mobile stations 11, 12, 21, 41, 42 and 43, and transmits the received response signal to the radio network controller 50.

[0038]

In step 1007, the radio network controller 50 transmits a service data to the base stations 10, 20 and 40, in accordance with the response signals received from each of the mobile stations 11, 12, 21, 41, 42 and 43. In step 1008, each of the base stations 10, 20 and 40 transmits the received service data to each of the mobile stations 11, 12, 21, 41, 42 and 43. The radio network controller 50 can be configured to perform a predetermined processing on only a

predetermined number of response signals (for example, a first response signal). The predetermined number of response signals are transmitted from each mobile station 11, 12, 21, 41, 42 or 43 joining in the multicast group A. In other words, any response signal following the predetermined number of response signals is unprocessed by the radio network controller 50. The radio network controller 50 can determine any number (for example, one, two and so on) as the predetermined number.

[0039]

The mobile communication system according to the embodiment can reduce the load on the radio network controller 50 caused by response signals which are transmitted from a plurality of mobile stations 11, 12, 21, 41 42 and 43, and which reach the radio network controller 50 at approximately the same time, when common information are transmitted to a plurality of mobile stations like multicast communication or broadcast communication.

[0040]

[Effects of the Invention]

As described above, the present invention can provide a mobile communication system which can reduce the load on the radio network controller during multicast communication, a mobile station and a radio network controller which can be used in the above mobile communication system.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a diagram showing the entire configuration of a mobile communication system according to one embodiment of the present invention.

[FIG. 2]

FIG. 2 is a functional block diagram of a mobile station in the mobile communication system according to one embodiment of the present invention.

[FIG. 3]

FIG. 3 is a functional block diagram of a radio network controller in the mobile communication system according to one embodiment of the present invention.

[FIG. 4]

FIG. 4 is a sequence diagram illustrating the operation of the mobile communication system according to one embodiment of the present invention.

[FIG. 5]

FIG. 5 is a diagram for explaining broadcast communication according to the prior art.

[FIG. 6]

FIG. 6 is a diagram for explaining multicast communication according to the prior art.

[Description of the Reference Numerals]

10,20,30,40 --- base stations

11,12,13,21,22,31,32,41,42,43---- mobile stations

50---- radio network controller

[Name of Document] ABSTRACT

[Abstract]

[Object]

The object of the present invention is to provide a mobile communication system which can reduce the load on the radio network controller 50 during multicast communication, and a mobile station 11 and the radio network controller 50 which can be used in the above mobile communication system.

[Solving Means]

The radio network controller 50 comprises a control signal transmitter 50b and 50c configured to divide a multicast group into subgroups, to divide a control signal for the multicast group into control signals for the subgroups, and to transmit the control signals.

The mobile station 11 comprises a response signal creator 11c configured to create a response signal to the control signals for the subgroups, a transmission timing detector 11d configured to detect a transmission timing from the control signals for the subgroups, and a response signal transmitter 11b configured to transmit the response signal to the base station 10 with the transmission timing.

[Selected Figure] FIG. 1

FIG. 1

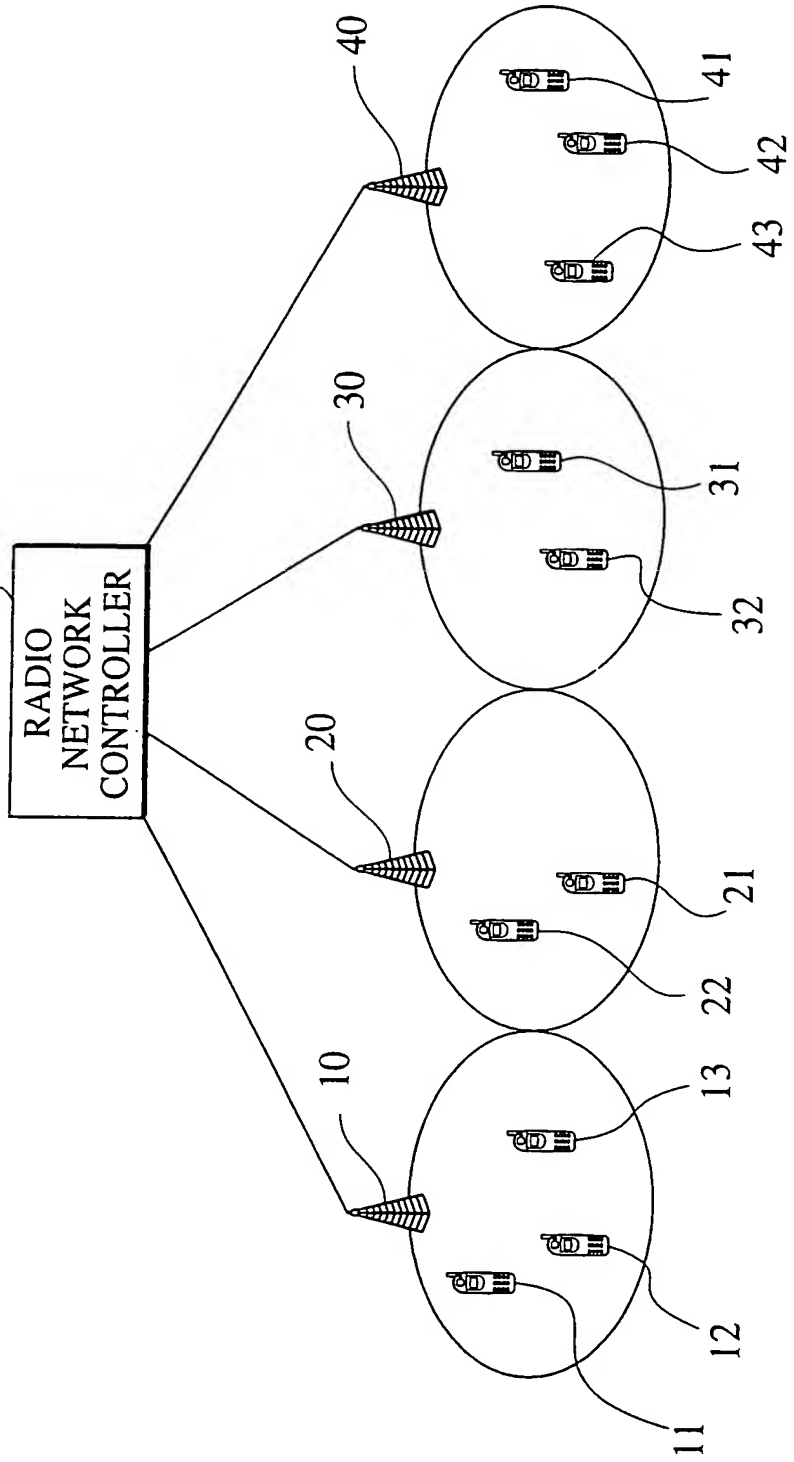

FIG. 2

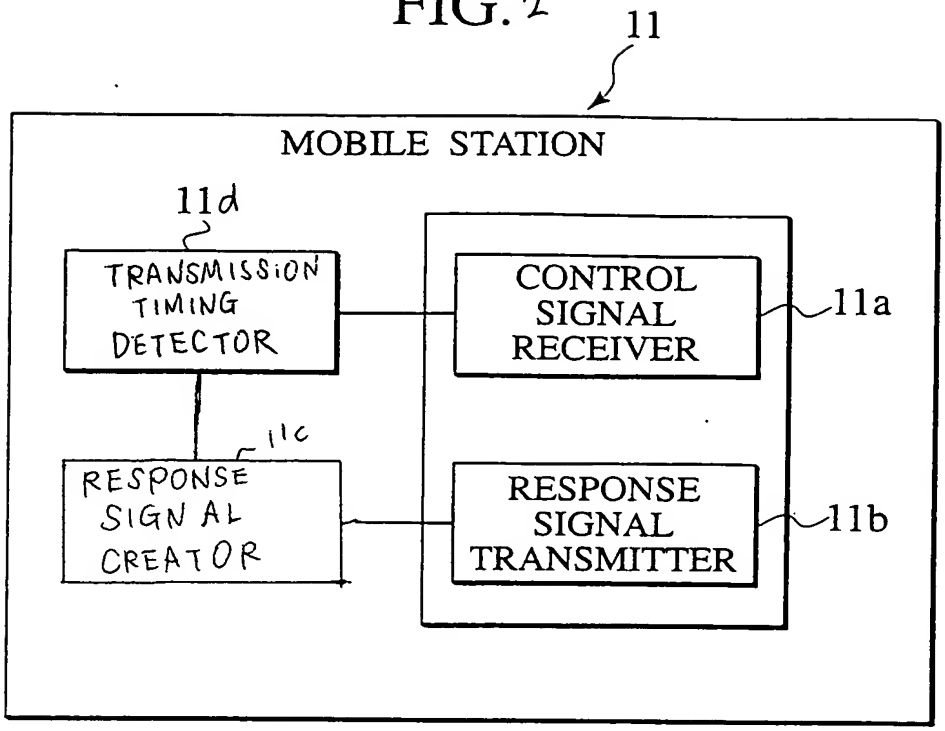
11
MOBILE STATION
11d
TRANSMISSION TIMING DETECTOR
CONTROL SIGNAL RECEIVER
11a
11c
RESPONSE SIGNAL CREATOR
RESPONSE SIGNAL TRANSMITTER
11b

FIG. 3

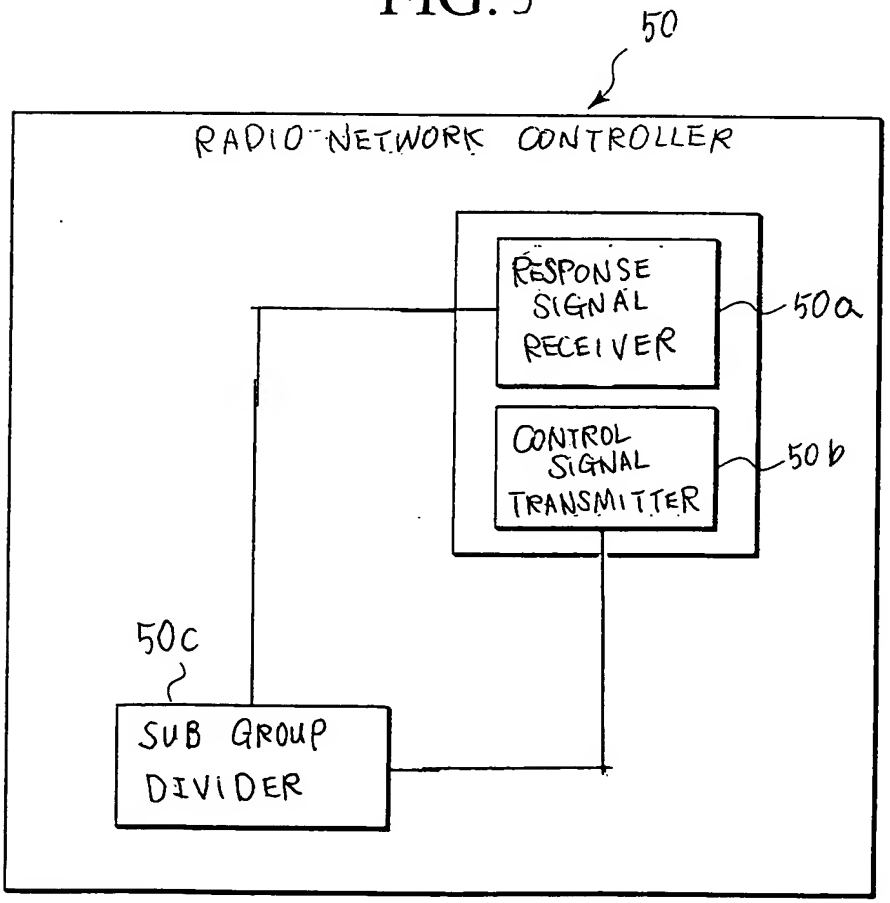
50
RADIO NETWORK CONTROLLER
RESPONSE SIGNAL RECEIVER
50a
CONTROL SIGNAL TRANSMITTER
50b
50c
SUB GROUP DIVIDER

FIG. 4

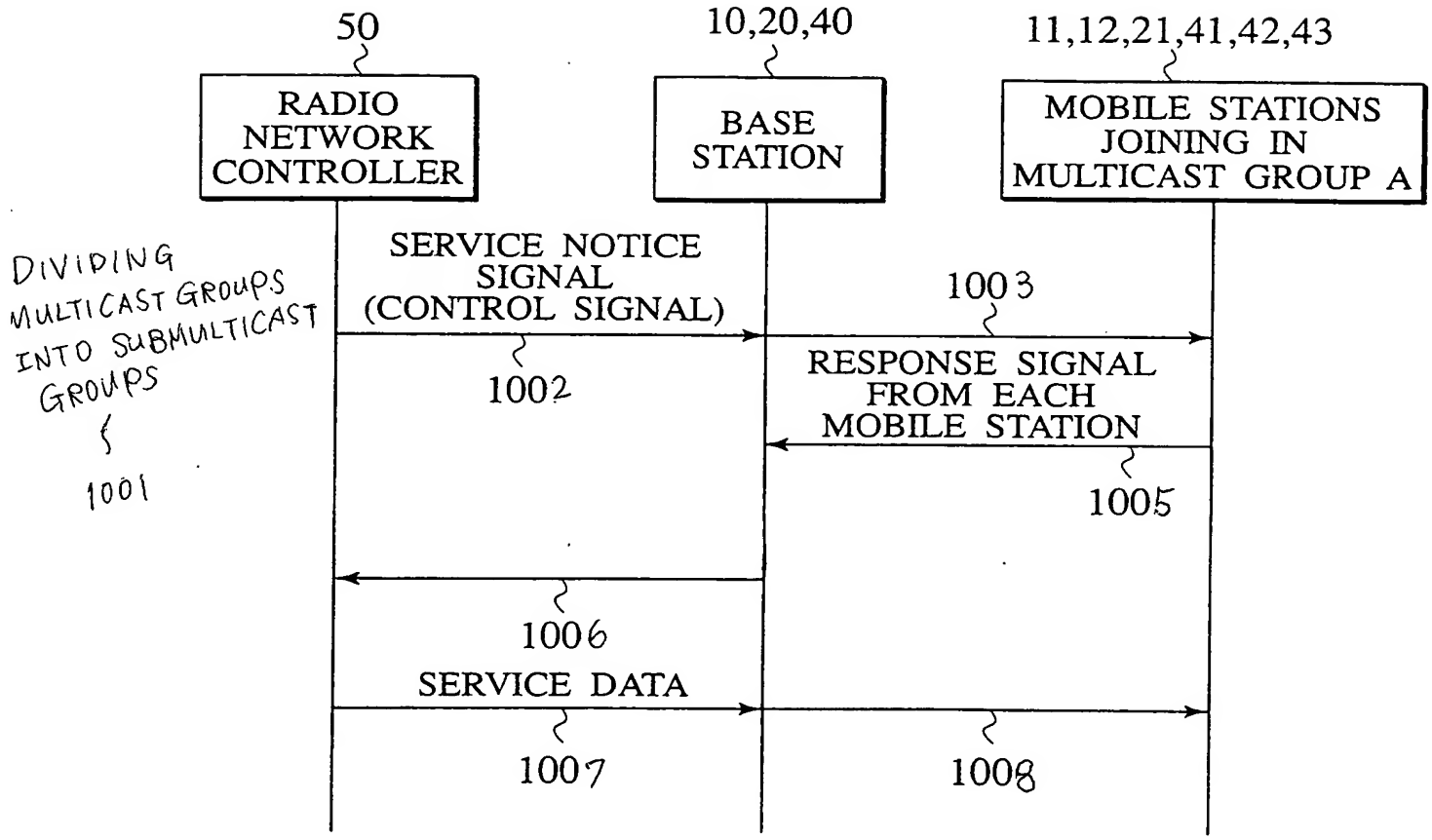
50
RADIO NETWORK CONTROLLER
10,20,40
BASE STATION
11,12,21,41,42,43
MOBILE STATIONS JOINING IN MULTICAST GROUP A
DIVIDING MULTICAST GROUPS INTO SUBMULTICAST GROUPS
1001
SERVICE NOTICE SIGNAL (CONTROL SIGNAL)
1002
1003
RESPONSE SIGNAL FROM EACH MOBILE STATION
1005
1006
SERVICE DATA
1007
1008

FIG. 5

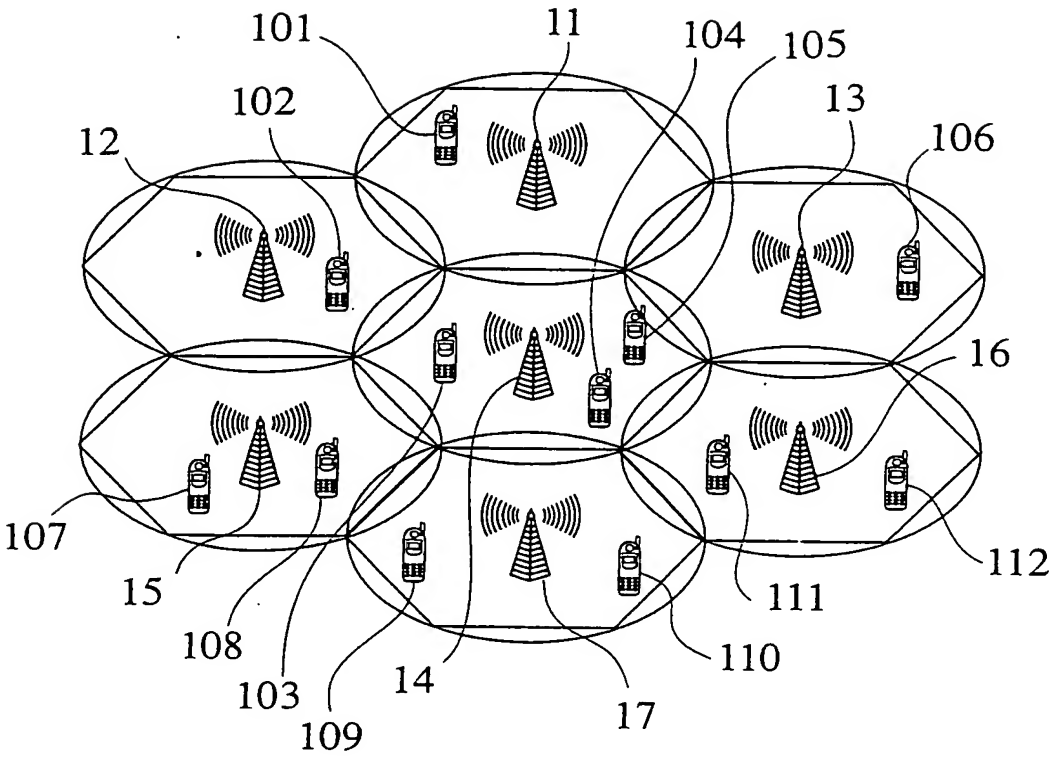
101
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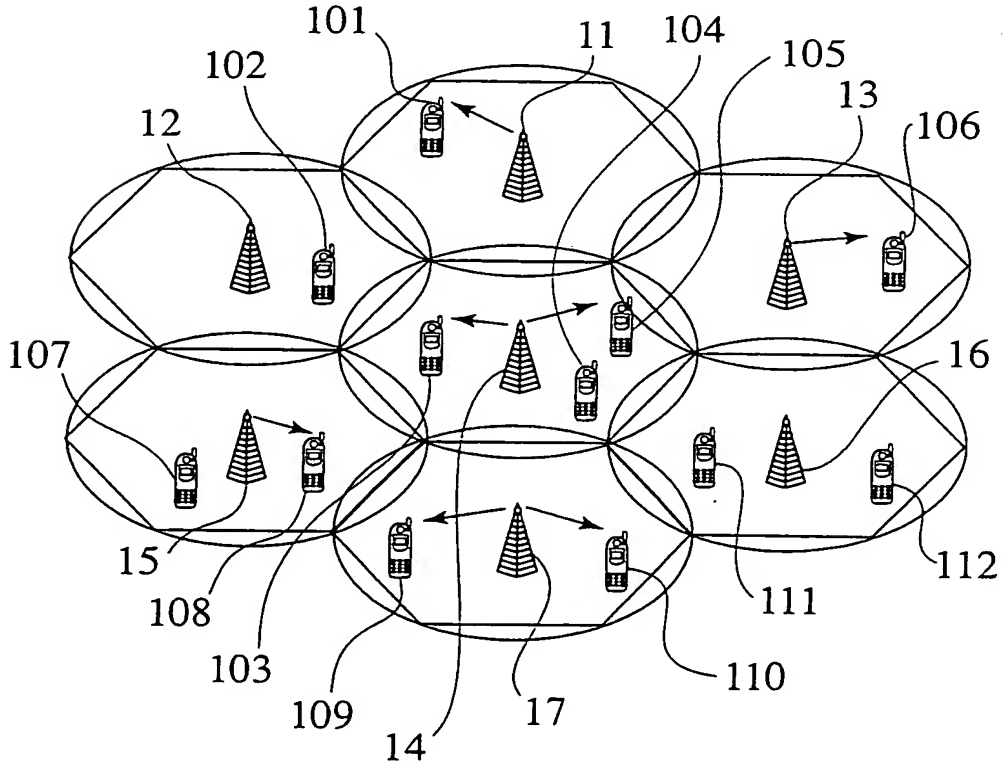
FIG. 6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